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A STUDY OF FOUR OYSTER REEFS IN MISSISSIPPI

JOHN OGLE
Oyster Biology Section, Gulf Coast Research Laboratory, Ocean Springs, Mississippi 39564

ABSTRACT A study of four oyster populations in Mississippi over 13 months (May 1978–May 1979) indicates that although oysters are sexually developed during most of the year (10 months), setting was variable in intensity, dependent upon location, and limited in all cases to one or two months. Mortality was variable, dependent upon location and was attributed to high predation at one station and to harvesting and fresh water at the other stations studied. Suggestions for management are discussed.

INTRODUCTION

The oysters and the oyster industry of Mississippi have been the subjects of numerous investigations dating back to the early part of the century. However, data that are available consist of oyster bottom surveys and studies of setting. The densities of oysters on various reefs have been mentioned (Moore 1913, Engle 1948, MacKenzie 1977). An evaluation of different cultch materials (Veal, Brown, and Demoran 1972) conducted during 1971 and 1972 was invalidated by the lack of a spat set. During seven months of 1972, spat setting was monitored on fouling plates at one station in Bay St. Louis, MS (Haburay 1977). Setting was monitored on fouling plates at five stations in Mississippi Sound for one year (October 1976–October 1977) and that same study (McGraw, personal communication) provided information on the growth rates of oysters. However, only one of the five stations was near a commercial reef (Biloxi Bay).

With recent interest in managing, developing and exploiting oysters, this lack of basic information has become apparent. This study was conducted to determine condition, setting, growth and mortality of oysters at four reefs in Mississippi.

MATERIALS AND METHODS

One-cubic-foot samples of reef material were collected monthly for 13 months at four stations: a lagoon at Horn Island, Graveline Bayou, a closed reef in Biloxi Bay, and a tonging reef at Pass Christian. The oysters at Horn Island are harvested publicly for recreation; the reefs at Graveline and Biloxi Bay are dredged for relaying and the reef at Pass Christian is harvested commercially. The Graveline and Pass Christian samples were dredged, while the Horn Island and Biloxi Bay samples were handpicked in shallow water. The number and size of all live oysters were determined and enumerated into four 25-mm-size classes: spat, seed, juvenile, and market sizes (Hofstetter 1977). The number of fresh single valves and boxes was determined and the percent of dead shell material was calculated. The average condition index was calculated according to the procedure of Hopkins (1949) with the shell cavity volume being determined according to the procedure of Galtsoff (1964). Gonadal development was determined on ten oysters by noting the condition of a gonadal smear. Hydrographic data, including temperature determined to the nearest degree Celsius and salinity determined to the nearest ppt with an American Optical total solids refractometer, were recorded for each station monthly.

RESULTS

Graveline oysters had the highest condition index (Table 1) throughout most of the study while Horn Island oysters had the lowest condition. Generally, oysters for all four stations had similar seasonal trends. Condition was high during May of both years (1978, 1979). However, values were also high during November 1978 and March 1979 for all stations. Values were low during the summer of 1978 and again during January 1979.

Sexually developed oysters were found during ten months of a yearly period for at least one of the four stations (Table 1). January and February were the only months for which no sexually developed oysters were found at any station. Horn Island oysters were developed the greatest number of months (10 of 13) while oysters from Biloxi Bay and Graveline were developed during 8 of 13 months sampled.

Setting of larvae, based upon spat set on shells, was variable in intensity, dependent upon location and limited to a couple of months. Spat were first noticed during July at Pass Christian with a peak of setting during August. Oysters at Graveline Bayou did not set until November with a peak showing up in the December sample. Setting was most pronounced at Horn Island with a peak during August. An additional set occurred during November at that station. A very low set occurred during August at Biloxi Bay.

Growth of size classes was difficult to follow at Biloxi Bay due to the insignificant set, and at Graveline due to the late set in 1978. Growth of oysters at Horn Island was faster than growth at Pass Christian. Oysters which set during August at Horn Island were seed size in 5 months and had started to show up in the juvenile size class in 9 months (Table 2). Oysters which set during July at Pass Christian were seed size in 6 months and were showing up in the

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TABLE 1.

Average condition index and percent sexually developed oysters based upon ten oysters from four reefs in Mississippi over a 13-month period.

Station	1978 May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1979 Jan	Feb	Mar	Apr	May
						Condition Index							
Biloxi Bay	7.83	6.40	4.55	5.68	5.31	6.04	8.53	7.74	4.72	7.65	11.80	9.10	13.34
Graveline	7.46	7.19	5.68	4.68	6.28	10.01	16.80	13.54	11.19	13.09	16.80	10.60	11.69
Pass Christian	8.24	4.74	4.56	5.59	5.22	5.51	12.13	8.08	11.00	9.43	17.00	10.00	9.78
Horn Island	6.60	6.63	4.56	3.97	6.09	4.04	7.21	7.78	7.78	7.19	8.80	8.34	6.09
						Percent Sexually Developed Oysters							
Biloxi Bay	90	100	100	90	70	10	0	0	0	0	0	70	80
Graveline	30	100	80	100	80	40	0	0	0	0	0	10	88
Pass Christian	80	100	50	80	70	50	20	40	0	0	0	90	100
Horn Island	40	50	90	100	100	20	0	20	0	0	0	90	90

TABLE 2.

Size frequency distribution of live oysters contained in a standard (1 cubic foot) dredge sample.

Percent Size Distribution	1978 May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1979 Jan	Feb	Mar	Apr	May
						Biloxi Bay							
Spat (0–25 mm)	1.9	2.0	1.7	7.0	1.0	2.9	3.6	6.0	1.8	1.2	2.1	1.7	4.8
Seed (26–50 mm)	63.4	23.0	33.5	18.5	16.0	15.1	16.5	24.0	17.2	12.5	45.7	21.1	20.8
Juvenile (51–75 mm)	23.8	35.0	39.1	57.3	44.3	52.7	44.4	32.0	38.4	43.4	44.3	38.6	48.8
Market (75 mm)	12.9	40.0	25.7	17.2	38.7	29.3	35.5	38.0	42.6	42.9	7.9	38.6	25.6
						Graveline Bayou							
Spat (0–25 mm)	1.4	0.8	1.2	8.2	8.3	1.1	56.3	64.8	49.8	53.9	59.9	55.0	56.9
Seed (26–50 mm)	21.3	13.3	25.9	17.0	19.0	46.3	14.7	9.3	14.8	10.4	10.1	11.3	14.1
Juvenile (51 75 mm)	28.1	40.7	31.3	32.7	31.0	37.9	11.3	14.6	15.5	11.4	11.9	14.1	14.0
Market (75 mm)	49.2	45.2	41.1	42.1	41.7	14.7	17.7	11.3	19.9	24.3	18.1	19.6	15.0
						Pass Christian							
Spat (0–25 mm)	6.4	1.9	41.5	51.8	40.9	26.2	19.4	15.3	14.3	10.7	12.9	13.5	7.7
Seed (26–50 mm)	28.2	23.5	11.8	9.4	19.8	5.0	9.2	13.3	73.2	16.6	29.5	18.9	27.8
Juvenile (51–75 mm)	30.9	26.1	17.8	17.6	26.6	18.8	10.2	16.3	7.2	19.8	37.6	15.3	28.9
Market (75 mm)	34.5	48.5	28.9	21.2	12.7	50.0	61.2	55.1	5.3	52.9	20.0	52.3	35.6
						Horn Island Lagoon							
Spat (0–25 mm)	34.9	12.9	19.1	73.0	46.7	56.0	63.1	35.2	52.5	56.0	50.2	51.5	29.5
Seed (26–50 mm)	48.3	73.9	62.7	25.0	29.0	19.0	20.6	31.8	39.4	32.2	46.1	22.7	40.8
Juvenile (51–75 mm)	13.6	10.8	17.1	2.0	18.3	7.0	13.9	26.5	7.6	11.0	3.5	17.7	22.1
Market (75 mm)	3.2	2.4	1.2	0.0	6.0	17.7	2.4	6.5	0.5	0.8	0.2	8.1	7.6

juvenile size class in 10 months. The November set of oysters at Horn Island had reached seed size in 4 months.

Horn Island contained the fewest marketable oysters, while Pass Christian had the most market-size oysters (Table 2). The greatest number of marketable oysters was typically found during the fall months. Graveline Bayou was depleted of marketable oysters during October due to dredging.

The amount of dead shell was high for Pass Christian, but the most dead shell occurred at Graveline after it was dredged. Horn Island contained almost no dead shell material (Table 3).

Monthly mortality was high for Horn Island and Pass Christian (Table 4). Horn Island oysters experienced high mortality during June, July, August, January, March and April. Pass Christian oysters experienced high mortality during October, November, December and January, and again during March, April and May. Graveline oysters experienced a high mortality during October, while the highest mortality for Biloxi Bay oysters was during August.

The highest temperature (34°C) was recorded for Biloxi Bay whereas the lowest temperature (6°C) was recorded for the lagoon at Horn Island (Table 5). The highest recorded salinity (32 ppt) was for Horn Island while fresh water occurred at Graveline and Pass Christian. The lowest salinity recorded for Biloxi Bay was 4 ppt and the lowest salinity recorded for Horn Island was 10 ppt.

DISCUSSION

The oyster population at Horn Island should be considered marginally harvestable. Reproductive potential was greatest at that station with two sets of spat occurring during the year, but there was not much cultch for the spat to set on. That resulted in the elongated shells and large clusters of oysters characteristic for areas of soft, muddy bottoms. Oyster growth in the lagoon was rapid but there were few market-size oysters, indicating a high natural predation and mortality. Oyster drills were probably the major cause of mortality. The protozoan parasite *Perkinsus marina*, responsible for oyster mortalities in areas of high salinity, especially during warm months of the year, was not prevalent during this study (Ogle, unpublished manuscript). The lagoons of Horn Island could be evaluated as spat-collecting areas utilizing artificial spat collectors.

The oysters at Graveline were generally the best oysters in Mississippi during this study period. The great number of large-sized oysters and their good condition was offset only by their being in an area closed to harvesting. The area was last harvested during February 1974 (W. J. Demoran, personal communication). Harvesting of the bayou during October of this study period for relaying of the oysters afforded the author the opportunity to investigate the effects of dredging on a reef and the effect of relaying oysters to new beds (Ogle 1979). Dredging of the bayou reduced the number of adult oysters and increased the percentage of dead shell, as would be expected. The highest monthly mortality was also recorded during the month that dredging occurred. These effects were offset by an excellent set of spat the month following dredging. Graveline Bayou, being protected from adverse weather and accessible to small craft, would make an excellent tonging reef. Consideration should be given to eliminating the sources of pollution into the bayou. This area would then serve eastern Mississippi, which presently has no commercial open oyster reefs.

Biloxi Bay, another closed oyster area, was dredged for relaying oysters during September and October. Dredging occurred adjacent to the sampling station, so effects of dredging were not recorded in this study. Biloxi Bay has been heavily dredged during the past several years. There was no significant spat set during this study and growth is known to be slow in this area, requiring 2 to 2½ years to produce market-size oysters (Ogle, unpublished data). The oyster bottom should be resurveyed to insure that it is not being overharvested and restrictions placed on the taking of oysters from this area.

Pass Christian was the only commercially harvested reef in this study. Harvesting occurred from September until April with heaviest tonging during October, November, December and January—months for which mortalities were also high. Interestingly, these were also months with the highest percent of marketable oysters. Mortalities during March, April and May were attributed to low-salinity waters from the flooding of the Pearl River and the opening of the Bonnet Carré Spillway on April 16, 1979. Should fresh water persist and mortality increase, planting of seed oysters may be required.

This study should be considered preliminary due to its limited scope and duration. In order to study the dynamics of a population adequately, especially oysters which require 2 years to reach a marketable size, several year classes should be followed over a period of several years. In addition, only four reefs were studied. Sampling should be expanded to cover all the major reefs in Mississippi. Because of the nonrandom nature of oysters on bottoms, the use of a standard volume sample only provided an indication of population dynamics. These data can then be used with surveys of the extent of oyster bottoms to estimate total oyster populations. The last survey of oyster reefs in Mississippi was completed in 1977 and should continue to be updated periodically.

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TABLE 3.

Composition of a standard (1 cubic foot) dredge sample.

	1978								1979				
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
						Biloxi Bay							
No. live	101	198	179	157	199	205	169	188	162	128	140	171	125
No. boxes	5	22	37	57	14	17	22	15	16	14	9	14	13
No. valves	17	11	48	60	3	6	26	17	9	7	6	11	11
% Dead shell	50.0	t*	16.7	16.7	t	4.0	8.3	8.3	4.2	t	t	12.5	50.0
						Graveline Bayou							
No. live	142	135	166	159	168	95	300	398	291	202	277	327	266
No. boxes	16	15	10	4	11	2	6	12	15	22	8	15	9
No. valves	32	28	38	33	19	89	88	60	38	36	30	11	12
% Dead shell	9.0	8.3	17.0	8.0	4.0	58.3	41.6	25.0	25.0	33.3	25.0	25.0	34.3
						Pass Christian							
No. live	110	157	135	245	196	80	108	98	56	121	85	111	90
No. boxes	3	10	2	18	8	30	46	40	20	15	7	25	34
No. valves	38	41	60	65	79	42	67	50	49	17	63	18	7
% Dead shell	25.0	20.8	50.0	41.6	50.0	33.0	17.0	33.0	42.0	16.7	50.0	33.3	50.0
						Horn Island Lagoon							
No. live	469	372	346	697	345	425	846	381	620	763	864	260	569
No. boxes	69	169	93	191	19	37	68	62	400	109	226	83	94
No. valves	5	4	10	9	7	4	7	8	3	8	5	6	1
% Dead shell	t	t	4.0	t	t	t	t	t	t	t	t	t	t

*t – trace of shell

TABLE 4.

Percent monthly mortality based upon fresh boxes and valves contained in a standard (1 cubic foot) dredge sample.

	1978								1979				
Station	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Biloxi Bay	11.8	12.2	25.4	35.6	7.2	8.9	17.2	11.1	11.2	9.4	7.9	10.2	12.9
Graveline	18.4	17.7	14.9	11.4	10.9	32.8	14.3	9.5	10.5	7.9	7.6	5.9	5.3
Pass Christian	16.7	16.3	19.1	17.0	19.5	38.9	42.4	39.8	44.3	16.3	31.2	23.4	29.4
Horn Island	13.2	31.5	22.0	21.9	6.1	8.4	7.8	14.8	24.5	12.9	20.9	24.8	14.2

TABLE 5.

Temperature (°C) and salinity (ppt) determined monthly for four stations in Mississippi over a 13-month period.

	1978								1979				
Station	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
						Temperature; Salinity							
Biloxi Bay	29; 6	34; 6	32; 8	29;16	26;18	23;22	18;26	11;20	7;16	13; 4	22; 4	20;10	23; 8
Graveline	22;18	30; 6	32;11	28;16	25;19	23;24	17;21	11;12	8;15	10; 2	14; 5	19; 0	25; 2
Pass Christian	22;17	28;12	28;18	28;14	27;18	23;18	17;18	11;15	10;16	15; 5	19; 5	20; 5	26; 0
Horn Island	24;16	30;12	24;22	30;25	-;22	14;28	19;32	12;24	12;26	6;11	16;14	25;10	26;13

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